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ABSTRACT

This case study provides an account of one teacher's background, experiences, and perceptions as she has changed curriculum, teaching approaches and methods, and professional roles in consequence of her experiences in the Memphis Urban Mathematics Collaborative. Data are descriptive and presented from the perspective of the teacher. The discussion is organized around three major areas: (1) the work context in school and classroom; (2) personal interrelation to the context of the work, the teaching of mathematics, and related professional issues and concerns, including family relations; and (3) the Collaborative activities and their influence personally and professionally upon the teacher. Experiences included learning how to integrate computers into advanced classes and receiving financial support to attend national conferences that made her take a different approach to her career as a professional leader, workshop instructor, curriculum developer, and a teacher. (YP)

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CHANGING TO MEET THE FUTURE:

THE MEMPHIS URBAN MATHEMATICS COLLABORATIVE

By

Dennie L. Smith and Lana J. Smith

Memphis State University

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I. INTRODUCTION

To "change" is to make different, to alter, to take something of the same kind and make it new or varied. It is a word whose meaning implies innovation and fresh approaches to the traditional ways of doing things. Educational "reform" and "progress" are other terms reflective of the impetus that has been given to changing and improving education in recent times. In general, education and educators are not viewed as being especially receptive to change, and yet change is the word that most accurately and appropriately characterizes the impact of the Memphis, Tennessee Urban Mathematics Collaborative on Susan, the individual teacher about whom this case study centers.

The Memphis Urban Mathematics Collaborative, established in September, 1986, serves 350 mathematics teachers mostly in junior and senior high schools of the Memphis City Schools, the largest school system in the state located in the largest urban area of Tennessee. The Collaborative is funded by the Ford Foundation and administered through the Memphis Urban League, Inc. under the governance of a twenty-member Advisory Committee. This Advisory Committee is composed of seven members from higher education, five from business and industry, two from the school district administration, one from the Urban League's Education Committee, and five teachers. It receives other support

services from the Memphis City Schools, area universities and community colleges, and several businesses and public agencies. It began by targeting a selected group of schools and recruiting an initial cadre of 150 teachers. The following year the number of teachers grew to 205, or nearly 60 percent of all eligible mathematics teachers in the district.

> Its purpose is to promote an environment of professionalism for mathematics teachers to assist them in broadening their horizons; to establish creative working relationships between mathematics teachers and other professionals in colleges and universities, and in business and industry; and to develop creative projects that will result in teachers' improved abilities to relate mathematical concepts to students from a practical perspective (Webb et al., 1989, p. D-2).

In its three year history, the Collaborative has offered a wide array of activities and programs for mathematics teachers, ranging from summer workshops, Swap-shops, meetings with business and industry leaders, summer internships, curriculum planning sessions, and stipends and travel support for attendance at a variety of professional meetings.

Collaborative activities have served as a catalyst for many of the changes that Susan has undergone personally and that she has implemented in her classroom. The impact of these activities are highlighted in Susan's evolving story, and the nature of these changes and their effects upon the needs, values, goals and interests of this individual, the workplace in which she teaches, and the colleagues with whom she associates is the primary theme of this report. The research is an ethnographical account of one teacher's background, experience, and perception of teaching mathematics in a secondary school located in this large, urban school system. Data are descriptive and presented from the perspective of one teacher who has been actively involved in the Collaborative. Names of people and places have been changed or distorted to preserve anonymity.

The discussion is organized around three major areas: 1) the work

context; 2) Susan's personal interrelation to the context of the work, the teaching of mathematics and related professional issues and concerns; and 3) the Collaborative activities and their influence personally and professionally upon one particular teacher in the Memphis area.

II. THE SCHOOL AND CLASSROOM IN CONTEXT

Approximately 650,000 persons live in the Memphis metropolitan city limits. Fifty-three percent of the residents are white and 47 percent are black. As part of that southern region of the United States that enjoys a temperate climate for most of the year, it is one of the fastest growing urban areas in the nation, experiencing a boom in economic growth and development in recent years.

Not unlike many urban areas, there are two separate public school systems serving the Memphis area--Memphis City Schools (MCS) and the Shelby County Schools (SCS). They exist as separately funded and administered systems, although ironically, both systems house their administrative units in one building located in the center of the city. Attendance in the systems is determined by geographic home location with students who live in the incorporated and annexed areas attending city schools, while others attend county schools. The MCS system is under court-ordered busing to achieve integration. Thus, the makeup of each system reflects common characteristics of other similar urban configurations--i.e., the county system is largely white, suburban, and economically more advantaged, while the city system is 78% black, more inner city, and suffering all the ills of time, crime, and underachievement. There are 153 schools in the MCS district and 49% of the students are in government-funded lunch programs.

Memphis has 15 senior high schools (grades 9-12 or 10-12) and 14 junior/senior high schools (grades 7-12), with a combined enrollment of 22,000. Fifty-two percent of the high school student population is female and 48 percent is male. Approximately 77 percent of the students are black, and 23 percent are white. Sixteen percent are eligible for federally funded lunch programs. Thirteen percent of MCS high school students dropped out during the 1987-88 school year.

The MCS district employs approximately 350 mathematics teachers out of a total of 2,402 secondary teachers. Ninety percent of the math teachers are certified to teach mathematics and all hold at least a bachelor's degree. The black/white and male/female ratio of math teachers is a close reflection of the entire population of the secondary teachers--64 percent are female and approximately 52 percent are black. High school teachers' salaries range from $18,000 per year for instructors with a B.S. degree and no prior experience, to $36,000 for instructors with a Ph.D. and 25 years of experience. An additional $7,000 per year can be earned through the Tennessee Teacher Career Ladder Program.

Approximately 16,000 Memphis public high school students enroll in mathematics courses each year. Graduation requirements include two units of mathematics from among the following courses: high school arithmetic, Algebra I, Algebra II, Geometry, Pre-Algebra, and Applied Mathematics. In addition, students who meet course prerequisites can take Trigonometry, Advanced Algebra, Advanced Math Survey, and Calculus.

Norton High School is not a typical city high school. It is a part of the secondary system of magnet (Optional) schools established in the city school system in four categories: 1) international studies; 2) college preparatory; 3) health sciences and engineering; and 4) creative and performing arts. The Optional Schools programs were organized after a 1972 court-ordered desegregation mandate resulted in more than

one-third of city students transferring to private schools. Norton is the only creative and performing arts high school and its students not only complete all of the state requirements for high school graduation, but also pursue an intensive course of study in one or more of the areas of visual arts, music, dance and gymnastics, or drama.

Located in the geographic center of the city and in a middle-class housing area, Norton consists of approximately 850 students, 50 teachers, a principal and vice-principal. One of 15 senior high schools in the city, its student ratio is 53% percent white, 47% percent black, and more than 70% of its graduates elect post-secondary education. Of the 850 students, about 300 are not part of the optional program but attend because they are assigned district with some of these students bussed from a distant, all-black junior high.

Enrollment requirements for the optional program at Norton generally consist of filing an application with the consent of parents or legal guardian, submitting letters of recommendation from previous teachers, counselors, or administrators, and auditioning or interviewing in the selected area of performing art. Portfolios or samples of work are requested as needed in the selection process. After being admitted to the optional program, students must maintain a passing average and meet all the requirements of their major department.

Norton High School's staff consists of 52 teachers, 60% white, and 70% female. The majority of the staff have Master's degrees in their field, 10% have 30 semester hours above the Master's, and one counselor has a doctorate. The math department consists of six teachers, four women and two men, all of whom are certified to teach math.

The four female math teachers at Norton have all participated in various outside professional activities such as those provided by the Collaborative, but because they all teach different classes and possibly

because of personality differences, the math department at Norton has not bonded personally and professionally as a group. They do not have formal departmental meetings and only meet informally at lunch or during the day if they meet at all. Susan feels this is an area where the math faculty could improve.

> I think the department would be stronger if we could get together and discuss some things and try to pull together, instead of each person doing his own thing. It's just not a very cohesive group and it never has been as long as I have been here. There are some who feel very strongly that they aren't going to do anything extra unless they get paid for it and meeting together would require taking our personal time before or after school. In teaching you can't have that kind of attitude if you like the work and really want to teach and do a good job. You're going to do what you have to do.

Another organizational and administrative matter about which Susan felt there was some room for improvement was the department chairship. Department chairs at Norton are elected each year, but has no real authority, and does not get extra compensation or time for the responsibility. Reflecting on this arrangement and situation, Susan stated:

> About all the chair does is hand out mail. I wish it were different and that the chair had more responsibility and say-so about what goes on. As it is, they can't do much to change anything. A lot of schools are this way because the Board can't pay extra or arrange extra time for the responsibilities, so they don't ask us to do extra things. I think the principal is sensitive to the faculty's time, energy, and compensation they receive for these things, too.

The statements above point to some of the most unique aspects of this particular school and the individual group of teachers who make up the faculty. Because Norton is an optional school for the performing arts, the teachers in the arts areas give time much beyond what they are actually compensated for in order to have the truly outstanding arts departments that they are well known and respected for having and which keep enrollments at levels necessary for continuing the concept. In contrast, some of the academic area teachers feel they take a secondary

emphasis in the school's mission, teachers' salaries in general are too low, and there is not a strong bargaining unit for changing these factors.

As in many schools, the individual character of Norton is probably most reflective of the principal who has been the chief administrator there for 10 years. It is, again, not a typical role he plays. The two most atypical facets include balancing the academic with the arts program and dealing with the very real "artist's personality" in both teachers and students. Susan has found him to be always supportive, respectful of her as a professional, and willing to extend the responsibility of academic freedom to faculty whom he trusts to have the students' best interests in mind.

> I like him because he lets me do my job without interfering. If I go in and ask for something, he says 'sure,' and finds a way to help me try things. He's also very good about when you are sick, or if you have to be out for family problems. He wants you to be there, of course, but he understands and doesn't give you a hard time about it. He respects the fact that I know math. He may know, also, but he doesn't push what he thinks should happen in math on me. He considers us professionals and lets us do our jobs. He is not nearly so good about letting some teachers do things, however, if he is not convinced it's in the best interest of the school or for the students' benefit.

Susan has had the same mathematics supervisor for the six years she has been at Norton and speaks highly of her also.

> She has a very positive attitude and that's why I like her. When she comes to observe or evaluate, she tries to point out what you do well. She lets you know if there is something that is not good, but as much as possible, she is positive and constructive. She has been very helpful in everything I have ever asked of her.

Susan's students are not really typical either. Approximately 70% of Norton's students go on for post-secondary study, whereas more than 95% of Susan's will attend college. Although all of her classes are advanced levels, the school context still effects their attention to the academic program.

> Being a student in the optional program means that the students have to practice long hours and go on trips all over, so their minds aren't

> always on mathematics. If it comes to a choice between math homework and practice for a performance, they are going to practice. The hardest part for me is keeping up with them when they are in and out so much and some for extended periods of time while keeping the instruction going for the others. I try to be fair with the students and I don't always draw a hard line when maybe I should. I teach the honors students and I feel like they have some sense and I respect them. I also try to work with the teachers and be as fair as time goes, but it's difficult sometimes.

Another atypical aspect of Susan's assignment is that she has many of the students who are following the advanced mathematics track for two to three years. There are advantages and disadvantages to this she claims:

> The advantages are more important. Teaching Algebra II, Trig, and Calculus, I know from the Calculus what they need to learn in Algebra II to be ready for it, so I emphasize that, whereas another Algebra II teacher wouldn't know or do that. I don't think teachers can realize how important some of the material is for learning Calculus later. And the same is true for Trig and Advanced Math. I have my Advanced Math class like I want it, and I'm teaching them what I want them to know when they get to Calculus.
>
> And the disadvantage? They get to know me too well. In general, at the end of a year with a class, you tend to get more friendly with them than at the beginning. But when they come in the second year, they are already friendly.

One particularly typical aspect of mathematics instruction at Norton, just as in many of today's high schools, is that students tend to drop out of math when the state requirements for graduation have been met. Last year at Norton there were 150 students taking Algebra II and only 85 continued with Trig. As Susan explained,

> . . . .then they drop out at semester when Trig is finished and Advanced Math starts--which bugs me to no end. There are various reasons for it. Some of them fail or they have to have other credits in order to graduate. Some just don't want to work any more. Out of the 60 who began Trig this year, I have 30 left in Advanced Math and only 13 of 16 who began Calculus.

Susan sponsors Mu Alpha Theta, a national honorary math association for high school students at Norton. It is a very active organization with strong participation every year at state competition and numerous other math contests in the area. One of the club's major projects each year is the sponsorship of a city-wide junior high math contest which has become

a well-known and -attended event each year.

An indication of the respect and high regard the students have for Susan occurred on one of the days when the interviewer was meeting with her. When the students attend competition, Susan usually goes along as a coach or sponsor, but on this particular occasion, another teacher had taken the group. When the students returned to campus, they made their way immediately to Susan's classroom to share their accomplishments with her, and to receive the praise they knew she would have for them for representing their school so well. There was sincere and mutual respect in this interaction that was deeply rewarding to observe.

III. THE LIFE AND WORK OF SUSAN: MOTHER, TEACHER, PROFESSIONAL

Susan turned 40 this year--an event which she describes as "awful" and unlike turning 30 or any previous age. A change from one decade to another and a passage into her sixth year of teaching mathematics at Norton High School may have been no small turning point for Susan personally and professionally. These are often the years when others are lulled into the tranquility and security of routine teaching. Not so for Susan. She has always sought, but has not necessarily been successful in finding, motivation through collaboration and continued educational and professional growth. Resources have been limited for professional growth activities and travel and she is the only one in her school who teaches the subjects she does. She described herself as becoming potentially near to suffering from teacher burnout. Thus, when the local Math Collaborative Coordinator called one day and asked her if she would be interested in an opportunity to go to North Carolina to learn about using computers and calculators in advanced math curriculum, she said, "Sure." She further

explained, "I look for things like that. I need things like that. Maybe everybody doesn't, but I do." This workshop was a highlight for Susan -- a new beginning that brought renewal and energy to her teaching as she sought and received permission to "do away" with the textbook and adapt new methods and approaches to the teaching of advanced mathematics in her classes.

Susan didn't set out to be a teacher. In fact, like many other adolescents, she left for college in her native state of Arkansas determined not to be like her mother and father who had been high school teachers of Home Economics and math and science. After two years, she transferred to Central College in another state. She explains,

> I was going to major in chemistry, but my college didn't have a chemistry degree. I decided to try math. Here I was with only high school Algebra I and Geometry trying to major in math in college! And I did it. And I'm glad I did. I've been real happy with what I chose to do, but it wasn't any major thing I had decided I had to do when I left for school.

After receiving the B.S.E. in mathematics, she stayed in Oklahoma for one year teaching in an inner city junior high school where all of her first year idealism quickly faded.

> It was just a very, very rough year. I went in thinking kids were like I was--that they wanted to learn and they would be ready to go. But they weren't. Some of them couldn't even add and subtract. It was a real eye-opener. I remember at the end of that first year, the principal said to me, 'It wasn't that bad, was it?' But it was, and I told him I was going home.

Susan reflected on the undergraduate teacher training she had received to prepare her for this first experience:

> The teaching methods courses didn't do very much for me. If I had taught and then gone back, it would have probably been different. But I never considered that there were kids who didn't want to learn, and so those theories about what to do when this happened, just went right over my head. If I had known what I was getting into, I would have picked up on a lot more than I did. I also felt that I wasn't trained to teach the areas I was assigned when I began teaching. I received a good mathematics content background, but no one taught

> any techniques for teaching Trig, for example. I always wished there had been a course to train me to teach what I am teaching, not just courses to train me mathematically.

Instead of going home to Arkansas after that first, less-than-ideal year, Susan moved to nearby Memphis, Tennessee, just across the Mississippi River and began again--this time in a private school teaching all the math they offered from eighth grade through twelfth. Things went well and she continued there for four years until she married and moved to Texas. It was during this second teaching interval that Susan began graduate school and completed the Master's of Science degree in Education, an experience she gained with a different perspective. She explained, "I value this degree more than my Bachelor's but that's because I had taught. I could see more things that I could go back to my classes and teach."

When she moved to Texas, she intended to work in government with her husband, but, she explained, "When September rolled around, I missed school. It was a funny feeling to have school start and I wasn't there." In October an opening in a relatively poor area of the city, in a primarily Hispanic high school became available, and Susan decided to give public school teaching a second chance.

> I joined the faculty after the students had had three substitutes. So you can imagine what it was like when I stepped in. I taught basic math the first year. The kids were tough, but everything considered, things went well and I was pleased with the year. The second year I moved into Algebra II.

At the end of the semester, Susan transferred to Saudi Arabia with her husband who was assigned to teach English as a second language. She taught one year while there at an international school and then resigned to become a fulltime mother of two children, Jenny (now 11) and Leah (now 8). When Leah was about two and a half, it became apparent that she had cerebral palsy and needed help. Thus, Susan and her family returned to the medical and educational resources of the Memphis area they had left eight

years previously.

Upon returning to Memphis, Susan with some reservation applied to teach in the city school system. The reservation was borne of still vivid recall of that first year she had spent in one inner city, urban area and the fact that she had been out of education for six years. She also had a family now, a child who was non-ambulatory and required quite a lot more time, attention and energy than when she had taught full-time before. She interviewed for the Norton High School job, qualified, and was hired to teach what she has now taught for six years, Algebra II, Advanced Math, and Calculus. Susan described that first year:

> I had a difficult time because I had been away from teaching for six years and away from the American system. I remember looking for something, someplace to go for help. I took advantage of the SECME workshops (Southeast Consortium for Minorities in Engineering). They hold two-week workshops in the summertime to train teachers for getting students ready to go into engineering. I thought that these would give me some background, ideas, and applications that would provide some current thoughts about what is going on back in the states. The emphasis was to get minority students to take advanced math courses so they could go into engineering. They were not exactly courses that I needed, but they were very helpful. I jumped into teaching Algebra II, Trig and Calculus and there was a lot I had forgotten. I studied hard. Most nights I was up until 11 or 12 o'clock just preparing for the next day's classes and keeping a step ahead. I felt like my background was good, but you really have to be on your toes when you are teaching advanced classes.

Today Susan finds balancing a full-time job with the demands of two children, a home, husband and recently widowed mother-in-law a challenge she meets with a quiet, inner-strength nurtured in competence and love. A typical day for her begins at 5:30 a.m. She dresses and takes care of the youngest child, who is handicapped, while the oldest dresses herself. Her husband, to whom she gives lots of credit for making it all work well, prepares breakfast for the family and drives the girls to their separate schools on his way to work. Susan arrives at school each morning about 6:45, checks in, and prepares for the beginning of the day at 7:30. The school day ends at 2:15, but Susan remains each day until about

2:50 when she leaves to pick her oldest daughter up at another school. Her youngest daughter is transported home in the afternoons by the handicapped bus services of the Memphis City School system. She is met there each day by Susan's mother-in-law who has graciously and generously arranged her own work day so that she can be at home when Leah arrives.

After a short time of visiting and relaxing, Susan begins dinner preparations and the family eats an early meal together. Time is consumed after dinner by assisting with the children's homework, a few household chores, and sometimes as much as two hours of grading homework, preparing lessons and tests, and organizing for the week. "It's not always a terribly exciting day, but it's full," Susan laughed.

As a teacher, Susan is best characterized as student centered. Her major concerns for the teaching of mathematics are focused on individual students and helping them meet their potential for learning. Of particular concern to her, especially the gifted students she teaches, is that they will lose their motivation to continue learning and that they won't have available the technology they need to help them learn the concepts more efficiently and in more satisfying and motivating ways.

> I always worry about the kids. Those who won't do the work or do not have the basic understanding they need before they come into my classes. I would like to see more of the black students and girls move up to the higher math courses. I think somehow we discourage these students very early and I don't know how or why that happens.

A particular teaching goal for Susan is to cause students to begin to enjoy learning math earlier and to sustain that motivation throughout an advanced course of study.

> Students are turned off to mathematics by the time they get to high school. A greater emphasis on math in the elementary schools would help as well as additional training for teachers in the use of manipulatives and the teaching of 'why' of math as well as the facts of math. We must find ways to increase their interest and motivation for investigation.

Susan recognizes that as a teacher she must anticipate student needs for the future for those who will go on to college as well as those who will discontinue math study at the end of high school.

> There is more demand for students to know math today--even the factory workers. Not all students are going to go to college and even those who do are also going to need more statistical approaches than we are giving them now.

Meeting the demands for increased knowledge and better preparation in the future, Susan believes, will require new technology and different approaches to the teaching of math, a reason she has changed her curriculum to the extent she has already and why she is looking forward to other applications in the future.

> I would like to see increased use of technology in the classroom. Right now there are still a lot of limitations on hardware and software for widespread classroom use. In some places teachers and classes are able to work together to solve problems and collaborate via modems. I would like to be able to explore this option, too.

As a professional, Susan expresses confidence in her training, experience, and knowledge of students to find ways of selecting and matching curriculum to students and guiding them to meet the challenge of becoming mathematically competent. In an elaboration of what it meant to her to be a "professional," Susan explained that it meant being acknowledged as an expert and having some autonomy for teaching the content in ways she thinks is best for students.

> I don't mind staying within certain reasonable bounds of a board directed curriculum. But I know my subject, and I know my students. I want the freedom to choose things to teach and that I have judged to be useful for them. I don't want someone standing over me with a stick telling me how to do my job. A 'professional' just does it. I know there are teachers who don't do that. I'm not blind. But I like to be treated like that. It's the way I work.

For Susan, the teacher's role in the curriculum-teacher-student flow is not so much to generate the curriculum that will be taught, but more like going into a huge educational supermarket where she can pick things up to use, put them in her basket, and wheel it out to the classroom.

> That's what I do. I don't think things up. I borrow and use all I can and I fight for the freedom to do that. There is no conflict in this supermarket idea and my belief that teachers should be more involved in determining the curriculum they teach because when you write curriculum, you just pull things together anyway--what order to do this in, what to emphasize, and so on. The Collaborative has helped us do this recently. They got together teachers from every grade level and a group for each subject and we talked about the curriculum and what we thought should be changed and what should be added. We wrote up the suggestions and are going to give them to the curriculum coordinator. We're getting involved now and it's because of the Collaborative. In times past, the curriculum has just been handed down to us and some things didn't get done very well or a lot of time would be spent writing things that just couldn't be followed.

Choosing from the array of possible things to teach in each subject is guided for Susan by the type of students she has, how she thinks they will ultimately need mathematics, and her own conceptions of mathematics.

> Mathematics is a way of thinking. It's analytical, it's abstract, and it can even be creative. It teaches kids to use their powers of reasoning and it has a lot of practical uses. When kids get out into the work world, they are going to realize math does them more good than what they think it does now. Being a teacher, that is hard for me to fully explain to them, because I've never been out there either. I've not experienced what people use in math in the business world, the factories, and other professions. I have to depend on what NCTM and others tell us and use my judgment as best I can from there. I use a lot of engineering applications because I have a lot of students who want to become engineers and because I have some background from workshops I have attended that were designed for preparing kids to become engineers. And everyone, no matter what field they end up in, is going to be required to know more about statistics. I am doing my best to work more of this into all of my classes.

IV. PROFESSIONAL REVITALIZATION THROUGH THE COLLABORATIVE

When Susan speaks of the Collaborative and its impact on her personally and professionally, there is a visible change that anyone would notice. Eyes sparkle a little brighter and energy that dips from too-long days is reclaimed. Revitalization is just one of the benefits Susan has received since she and the Collaborative found each other. She summarized some of the experiences that have enhanced her role, created job variety, enriched her with new competencies, established a close personal and colleagial relationship with a teacher in another school, and expanded her professional autonomy:

> I got involved in a secondary way. The first year the Collaborative was operational, they targeted several schools and Norton was not one of them. I knew about it and was a little bit jealous that we weren't included. The following summer there was a workshop in North Carolina that was available and the coordinator called me and asked me if I wanted to go. That experience was the true turning point for me.

The North Carolina workshop had the essential characteristics and support for helping teachers implement new curricular ideas. First the workshop introduced and taught math concepts to the participants; secondly, computers and software were used to demonstrate the new ideas; and most importantly, Susan was able to bring back the software and related materials for implementation into her classroom.

> The workshop concerned getting more computers and calculators into the curriculum and approaching math from a more problem-solving, thinking approach. These are some of the things being emphasized and promoted by the new NCTM standards for mathematics. Although I had thought about trying to bring computers into the curriculum as much as 6 to 10 years ago, the materials just weren't available. In NC they gave us a lot of the material to bring back home and use in our classrooms. They also taught me some things I didn't know or had forgotten about mathematics. I learned a great deal myself and that was one reason I felt so good about the experience. The data analysis

> aspects excited me and made me feel like these were the connections to the real world of math that the students needed and could use even if they didn't go on to college. This was the math the business community was telling us students didn't have.

When Susan returned from North Carolina, she was motivated to make some significant changes in the way she taught math in her classrooms. Her prior curriculum base had been heavily centered in the state adopted textbooks for the content and was traditional in the sense of following the prescribed textbook and school system mandated sequence and materials. Instruction was also traditional in that it consisted of short lectures on how to work the problems, followed by supervised classroom practice, homework, review of homework, and unit assessment. Susan approached her principal for permission to use the materials, computers, content, and concepts she had been inspired by in North Carolina and to move away from the textbook entirely for her fourth year mathematics students. She made a written proposal to the school district and was given permission to adopt and adapt the North Carolina curriculum to conform to the computer applications and to the problem solving/thinking approaches she had learned about in the workshop.

Although she has continued the more traditional curriculum in her other classes, she has incorporated the computer and many of the practical applications of math concepts into those classes also. The instructional events in her classes have also changed and consist usually of providing introductory explanations using a classroom demonstration computer, students following up with in-class group or individual assignments on the computers, debriefing their experiences, homework assignments with next day discussion, and assessment at appropriate intervals.

In discussing the specific changes in the classroom that resulted as a consequence of the North Carolina workshop, Susan said:

> Incorporating computers into all my classes has been the biggest change, along with the complete change from the MCS curriculum to the North Carolina curriculum for the fourth year mathematics students. I had to get special permission from the Board to make the change, and I am still teaching it that way because I think it is the best way. In fact, I am doing my best to get a lot of similar content and approaches into the curriculum review that we have coming up this spring and summer. Getting enough computers together for the students is still a problem, but we manage to get into the lab and to work in small groups with the ones I have in my room. These things are part of the change, too--working away from the textbook and using more cooperative peer learning and teaching. Computers have helped the students to visualize and to maximize their energy in solving problems. The emphasis today is using more manipulatives in elementary and junior high, but by the time they get to senior high, it is harder to find things they can manipulate.

Visualizing some of the odd shapes in mathematics, especially some functions that go beyond straight lines can be especially difficult for students. Susan elaborated with one example, "I would really like to do some more data analysis with students where they start with points and come up with an equation that goes through those points. You just about have to use a computer for that, at least on their level."

Susan's new approach to helping the students understand mathematical concepts through individual attention and with the use of the computer is illustrated in her approach to teaching Calculus.

> I was having trouble with students in Calculus because it took them six weeks to understand what maximum and minimum meant and how to graph some of these functions. You can do a lot of calculus work in advanced math when you use the computers to illustrate those functions....graphing by moving things, transformations, translations, moving them up, across, stretching and shrinking both ways.

Although Susan has been able to manage the small computer resources available in her school and through the Collaborative's help to get two computers and a printer in her room, she feels the resources are still very limited and that students need consistent access and the opportunity to use them on an independent basis. "I would like to see them have a computer situation where they could do homework. Not necessarily at home but maybe at school where the kids could come here or stay to use

the computers." Because of the limited access to computers, management of the instruction, even with a small group of students, has been the most challenging aspect of the curriculum change.

> The first and fourth periods could go to the computer lab down the hall since the computer teacher was free during that time. I had to send my other classes to different places in the building to work, such as the library and the science lab, while some of them remained in the room to work on the two computers here. I would give the students the material and let them work in groups. But when you send them away, the work is not nearly as effective. One person will work on the computer while the others talk and no one is there to keep them on task. I do give homework quizzes and put the assignments they do on their homework grades and I always talk to them about what they did when they come back. But actually it is the ones who stay in the room who are benefiting more because they have my input while they are working. I desperately need more computers in my classroom.

Another major change in the way Susan teaches mathematics has involved becoming comfortable with alternative teaching styles such as cooperative learning and peer teaching to develop the cognitive processing aspects of mathematical knowledge.

> A big change for me, and a skill I still need to work on, is letting the students use more cooperative learning and peer teaching. I tend to tell. That's the way I was taught and it's the way I've tended to teach. I'm trying to change some of that so the students can do more of the thinking.
>
> I was sick recently and one of the fourth year girls taught the class. The substitute teacher was very impressed and so were the other students. I would have never allowed that before, probably because I was never confident enough in my students. I have more confidence in them now and I have recognized that it's also really good for them. Anytime they have to explain something to someone else, or go over something they've learned with someone, it is going to help them remember it better. You don't learn things the same way, when you have to teach it to someone else.

A special serendipity in North Carolina for Susan was the opportunity to meet others who taught what she did. At Norton no one else teaches the advanced classes she does, and the opportunities to discuss content and techniques is limited. Ironically, she was assigned to room with another teacher from Memphis (Penny) who teaches similar classes and whom she had not known before. They became, and remain, very close friends. After

returning from North Carolina, they teamed together to present a similar workshop to local teachers and have been leaders of other in-service efforts locally to present and familiarize teachers with the NCTM standards as well as new and different ways to teach the curriculum, enhance the thinking skills required by math, and to incorporate computers into the content.

Susan expressed conviction that the Collaborative activities and involvement have given her, and other math teachers in the school system, opportunities to get some things accomplished that have lacked direction and leadership in times past. Most importantly, much of this leadership is now being called for from the teachers themselves in closer harmony with the local universities and the school's central administration. Susan feels that one of the major advantages the Collaborative has offered has been to directly inform and train teachers, rather than supervisors or others not directly related to the classroom, and present opportunities for them to then train others.

> I think teachers want practical ideas, but they respect them more if they know they have actually been used by other teachers and if they can see how they fit with what they are assigned to teach.

Specifically, Susan and her friend Penny took leadership roles in conducting in-service for other math teachers in the system. In previous times, inservice in math in the school system has consisted largely of general information presented by persons asked to come in for one day presentations. Susan and Penny introduced a statistics approach on the junior high level to teachers in a week long summer workshop and provided materials and strategies for practical application of the concepts. Susan described some of the frustrations that are nonetheless encountered even with volunteer efforts such as theirs and the way in which the Collaborative helped with this aspect also:

The workshop went very well. We were pleased with what we did and

> I think the teachers were, too. After the workshop, many of the teachers wanted to go back and use some of the things, but couldn't because they didn't have the equipment. Most of the teachers I have dealt with have wanted to try some things, but often get bogged down in the implementation. The Collaborative has been very helpful in helping us to solve some of these problems by providing resources or helping us to find ways to get them so that teachers can begin to do some of the things they feel are worthwhile.

The Collaborative has been active in organizing many other activities in which Susan has participated and which she believes have built on teacher needs as well as individual strengths.

> We had a Swap Shop where teachers in each subject area got together and shared ideas which the Collaborative later published in booklet form and distributed at inservice meetings. Our teachers came up with a lot of good ideas to share and use and that we knew could be used with the kids we teach in our part of the country.

A Speaker's Bureau of local university math professors as well as other math professionals from around the country was organized by the Collaborative and Susan availed herself of this resource by inviting several to her school to speak to her classes and to math events sponsored locally in the city.

> I wanted the students to hear others besides me talk about math, how it fits into the "real" world, what to expect in college, and what they would need to know for different professions they might choose. I wanted them to see and get to know people who had achieved success through their mathematical studies.

Another activity sponsored by the Collaborative included a probability workshop at a local university.

> The workshop was really helpful in that it provided many hands-on, practical teaching ideas. They also had speakers who had national acclaim and talked about some of the new trends in the teaching of mathematics. I think teachers like to hear people whose names they recognize from the textbooks talk about what is happening in their field. It makes us feel like we are more a part of the changes.

Near the end of the year, the Collaborative organized a curriculum review. Susan felt this was an especially good activity for involving teachers in curriculum in a direct and beneficial way.

> It gave teachers a chance to have a direct say in the curriculum they teach. We were asked to write our ideas down and submit them for consideration to the administrators and supervisors of instruction for changes in what is being taught and suggestions for ways it is taught.

> Teachers feel like they aren't given many opportunities for this kind of input and that no one wants to hear what they have to say.

And perhaps, from Susan's point of view, one of the more significant contributions for her and other teachers in this area has been the financial support for attending seminars and professional meetings to learn and to grow professionally with peers. This direct consequence of the Collaborative's support has especially enriched Susan's quality of worklife and inspired her with a heightened level of confidence. In her words.

> There are a lot of changes going on in mathematics, particularly right now. The Collaborative is providing ways of helping teachers see what the changes are and helping them to make those changes. In particular, they have provided money for travel and stipends for attendance at workshops, and helped us get the time and opportunities for many things. I couldn't have a done a lot of the things I've done here without their help. The coordinator helped me get the computer I have in my room. I probably never could have done that completely by myself. And, of course, they have paid expenses for travel, workshops and conventions that I could not have attended. It's made me feel more professional and has given me the incentives to try new things and to think 'anything is possible.'
>
> It makes me feel more professional because I feel like I'm more involved in what's going on in my profession rather than sitting in my classroom and having someone else dictate what I should be doing. I'm actually out there myself trying to figure out what I should be doing and coming back and trying some things. The Collaborative is providing ways for me to do that and it makes me feel good about myself and my job. Teachers get burned out. It's not an 8:00 to 3:00 job, it's a 7:00 to 10:00 job, six days a week and it's easy to get burned out. I've gotten a fresh start, some new ideas and techniques, new friends, and more confidence. I applied for a Rotary Initiative Grant this year and received this printer to use with the computer. I wouldn't have ever done that earlier. I have a tendency to think, 'Who's going to give me something?' Attending the national meetings has been exciting and given me a chance to talk with others. I'm a lot more aware of what goes on all over the nation as well as in other countries, now. It makes me feel like there are other teachers who are just as interested in doing the things I am doing, and that means a lot to feel like you may be on the right track after all.

This new confidence has given Susan a heightened sense of professionalism and the initiative to act on her convictions about what teachers can do to improve their teaching, the curriculum, and their students' abilities to better meet the future.

Although Susan teaches in a school that is unique in many ways, her

interactions with others through the Collaborative has given her informed perspective of the urban, largely black, system in which she works, of some of the problems that desperately need to be solved, and how the Collaborative can continue to be helpful.

> Part of the problem is money. If you are going to support teachers, send them places, and provide good materials, you've got to have money to do that. The MCS system doesn't have money for these things. The community ought to be supporting teachers in this way, but they aren't either. There are a lot of new programs being proposed in the city schools presently for the lower grades and for the inner-city schools where achievement is so low, and all of the money is going there. The Collaborative will have to find money to continue from a separate source and that may be advantageous, too, in that if the system supports us, they tell us what to do.
>
> Some of the city high schools don't have computers and several don't have advanced mathematics courses because the students have just not gotten that far. There is a difference in these students' levels of ambition and who's pushing them to go on with their education. There are a lot of factors involved with helping the inner city student and I'm not sure the things they have planned for them are the full answer. These kids don't want to come to school during the regular year, and they are proposing to send them through the summers and an extra hour a day. And something has to be done early. You can't wait until they are in the tenth grade and then tell them they are going to go on to Calculus. They have to be prepared. A lot of the elementary teachers don't have the math backgrounds they need to help prepare the students.

REFLECTIONS

Susan's name was at the top of the list when the Coordinator for the local Collaborative gave suggestions about who should be selected for this case study. In the other individuals, there were some more vocal, some more openly enthusiastic, some more convenient to access, some with more time to give, but none who had "changed" more than Susan. Changing routines, instituting new curriculum "on your own," adapting and trying out new teaching strategies, and assuming leadership roles means taking risks and being vulnerable to failure. These factors are inherent in change, and for this reason, people often fear it and especially, as they near those midcareer years, find it easier to level off in performance and

devote less energy to the classroom and the life of the school. This was probably the inevitable for Susan also if she had not become involved in the Collaborative and reached out for the challenges it provided her. The numerous changes, in almost every aspect of her career, that Susan has experienced since becoming affiliated with the Collaborative came at a time when she confessed she especially needed them, and they fit comfortably with her philosophy of life.

> I may be different from a lot of teachers, but change is what keeps me going. If I have to do the same things over and over for 15 or 20 years, I'm going to be bored to death. I have to change some just to keep myself feeling up about what I'm doing. I think it makes a difference to the kids. If you are bored with what you are doing, they're going to be, too.

A mild-mannered, low-keyed individual who doesn't have political ambition or need to be the leader of great movements, Susan has, nevertheless, found herself in a new leadership role and it has created some ambivalence for her:

> I am a little uncomfortable with this role and I fight it, but I feel good about it, too, in a way. I don't really see myself as a leader but in Memphis I guess I am probably the first one to do what I have done. I have people call me and ask me to come out and see what I have done. I don't mind helping teachers, but I have to really be on my toes and I still have some uncertainties--like is what I'm doing really what I should be doing, and when someone asks for materials, do I have what they need and things like that. I haven't been doing this long enough I suppose.

And where do the rewards from teaching come for Susan? She laughingly responded:

> My husband asks me that question all the time. It's not from money. I get it from inside myself. I suppose it's inborn. I like to see my students do well and I like to feel like I'm doing the best job I can do. As long as I feel that way I am happy. My students are good to me. They tell me they like me and they tell me they feel like what I am doing is worth it. My KIDS tell me that and their parents do, too. That means a lot to me. If it weren't for that kind of thing, I probably wouldn't want to teach for any amount of money, because it's a lot of hard work

V: GENERAL SUMMARY: ISSUES AND CONCERNS

1. As noted in the section above, Susan was selected for this study primarily because of the perceived changes she has made in her classroom as a consequence of the Memphis Urban Mathematics Collaborative. Other factors in her selection included that she could be classified as "mid-career," and that she taught in an urban, city system school at advanced levels of mathematics and with students who are "gifted" in several areas of classification. Thus, Susan's story offered a contrast within an urban system where so much time, attention, and resources have been given to students and teachers who struggle with declining achievement and lack of motivation. Many times the "Susans" who work with the brighter, more gifted students get lost in the national concern for those working with students at the lower end of the continuum, and they either leave the profession or stagnate with the daily and yearly routines of the work.
2. Although there are many cautions to be made about generalizing from one individual's experiences or implying that there are causal links between the Collaborative and the effects it has had in one area, there would be no denying its strong and positive impact on this particular individual and the students and colleagues with whom she works. Consequences for students, collaboration with others, and a refocusing of what mathematics instruction should be--the highest levels of concern when any innovation is being implemented--characterized all of Susan's responses during the interviews and indicated a depth of concern for her profession and its impact on the future that she had not had before she became affiliated with the Collaborative. More importantly, she has acted upon these

concerns by becoming involved in the professional meetings and activities and assuming some of the leadership and responsibility for making the changes that are needed.

3. One of the most salient impressions of the influence of the Collaborative upon this individual is the degree to which it has helped her exercise and develop a higher sense of professionalism. Prior to becoming active in the Collaborative, Susan was not a member, and certainly not a leader in any other professional associations. As a consequence of her greater involvement in the Collaborative and through it the National Council of Teachers of Mathematics, Susan has gained confidence in her ability to instruct other teachers, and select materials and teaching approaches which she judges to be more suitable for her special students. She has also demonstrated considerable initiative and autonomy through the implementation of the computer and related software in her advanced mathematics classes. These curriculum deviations were supported by the principal and mathematics supervisor because they viewed Susan as a competent and excellent teacher. Competent teachers can be trusted to make decisions about their instructional programs without having the so-called experts, who are many times far removed from students, dictate programs. This is especially true of teachers who have had opportunities to share ideas in national, state and local conferences about the most current trends and related teaching approaches for mathematics. Susan continues to try to change the mathematics curriculum by proposing a statistics course next year, which was delayed last year. As Susan's confidence continues to increase with her competence, she will undoubtedly have influence in establishing a functional mathematics curriculum for urban students.
4. Technology has not only changed mathematics education, but is

acknowledged as a prevailing force which teachers and students must utilize to prepare for the future. The Collaborative has provided the vehicle for one teacher to capture minimum computer resources to help provide mathematics experiences. Susan has overcome, or at best found a way to work around, many of the obstacles so often cited by teachers in the integration of computers into instruction and is making it work.

5. Susan expresses a need to know more about how mathematics is utilized in various vocations such as business, medicine, and other professions. Training and curriculum has often neglected that very few teachers have been in other work worlds than education and thus, do not have a background upon which to call for real worklife examples in mathematics.
6. The Collaborative, established outside the formal bureaucracy of the Memphis City Schools through the Memphis Urban League, has provided numerous professional development opportunities for Susan and others in the metropolitan area. Included among the more important ones, at least for Susan, was the North Carolina Conference emphasizing computers and technology. It was truly the "benchmark" experience that provided the impetus for the changes in Susan's teaching of mathematics. The opportunities to attend the national conferences also provided further opportunities for Susan to share ideas and gain confidence in the teaching approaches that are presently being utilized in her advanced classes.
7. A significant aspect of the Collaborative has been to support teachers helping other teachers. This has tapped the well of teacher empowerment that so much has been written about and discussed in professional arenas. Susan has somewhat reluctantly emerged into a leadership role by conducting professional growth workshops for

other mathematics teachers and is available to other curious teachers interested in implementing computers in their mathematics teaching. But she has also blossomed in this role and her effectiveness with others has been because they have perceived her as "one of them"--someone who knows their problems, their resource availability, and what is possible or not possible with students in the area. She is concerned about the future of the Collaborative because the funding source is not steadfastly apparent in the community. The Collaborative has managed, however, to make a little money and colleagial support go a long way to provide the opportunity for a competent, mid-career teacher to become revitalized about new possibilities for mathematics education and to pass them on to others.

8. Because Susan is "mid-career" she represents a profound, demographic change among teachers--i.e., a work force of people who have been teaching in their current school for some extended time. The sustenance of this group is critical, especially in light of imminent teacher shortage predictions, but also because it is this group who is the current reality of the workplace. If improvements and changes can not be made with and through this group, all other influences are likely to be negligible. It is apparent in Susan's story that Collaborative efforts have, indeed, made profound differences for her and others.

VI. METHODOLOGY

This case study provides an account of one teacher's background, experiences and perceptions as she has changed curriculum, approaches and methods, and professional roles in consequence of her experiences in the Memphis Urban Mathematics Collaborative. Data are descriptive and presented from the teacher's perspective.

Sample

The teacher selected for the study was chosen from a list of active Collaborative participants provided by the Project Coordinator. Initial discussions with the coordinator centered around choosing someone who was both active in the Collaborative and who would be cooperative and willing to devote the time necessary to complete the research. Other considerations focused on the significance of the contributions and interactions the individual had had through the Collaborative experiences. As described in the case study, Susan was identified through these discussions with the coordinator as being someone who had "made significant changes" as a consequence of her Collaborative experiences. Additional personal characteristics that were deemed important included that Susan was female, a mother of two children (one nonambulatory handicapped), a working spouse, had taught for several years in one school, and worked in a "special" (optional school) with gifted and advanced students. She was accessible to the researchers and willing to participate.

Data Collection

Initial contact to participate was made by the Project Coordinator. A followup contact was made at the school to introduce the researchers and to make an appointment for the initial interview. A total of four interviews (seven hours) were made by the researchers at Norton school during the months of April and May, 1989. All interviews were conducted in Susan's classroom during her regular 50 minute conference period and on two occasions, for extended periods when she was given permission by the principal to talk with the researchers rather than attend special events at the school. The interviews were tape recorded and transcribed verbatim immediately following the discussions. Intervening phone calls were made to clarify points and to secure additional information as the tapes were transcribed and the study was written. One interview was conducted with the principal of the school to inform him of the purpose of the case study and to discuss specific demographics of the school.

Data Analysis

The data were analyzed by coding each quotation into units that corresponded with the major divisions of the case report: Personal history, school and classroom context, and professional perspective and change as a consequence of Collaborative experiences. This information was culled and collapsed from the researchers' judgment of its pertinence to the purpose of the study and its contribution to the overall understanding of the impact the Collaboration has had upon this individual.

Limitations and Afterthoughts

Generalizability and causality are certainly limitations of any case study research. However, this data combined with similar stories from others involved in Collaborative efforts should provide a general perspective of the contributions made through wide-spread and diverse efforts across the country. This information was also gathered by researchers who have experience with inservice teachers in the local area and are familiar with the contexts in which local teachers work. We have attempted to tell the story from Susan's point of view. The fact that she is optimistic and positive, experienced (but not naive), and deeply caring of her students and their achievements probably impacts a great deal the perspective from which she tells her story.

CASE STUDY SUMMARY

This is the story of Susan and the changes she has undertaken in teaching advanced mathematics in an urban, optional high school and those she has undergone personally and professionally as a consequence of her involvement in the Memphis Urban Mathematics Collaborative. The story is told from first-person perspective and reveals not only the high regard Susan has for the Collaborative's support and extension of opportunities to learn new things and bring them back to her classroom, but also how these experiences have deepened her committment to her profession and students.

Noteworthy experiences for Susan included learning how to integrate computers into advanced math classes and receiving software that she could actually use with her students. This new knowledge and the necessary materials gave her the incentive to ask permission to step outside her prescribed curriculum and textbook and use the new materials and approaches exclusively in her advanced classes. She also accepted new professional leadership roles in teaming with another colleague to present inservice workshops about what she had learned to others in the local area. Financial support to attend national conferences has also allowed her to enrich her knowledge base and to feel more professional about her work.

The significance of Susan's story lies in the fact that she teaches advanced and honors students who will ultimately become the leaders of tomorrow's world and that so little energy and financial support has been given to helping teachers of these type of students. Susan is also a member of that group of teachers who have taught enough years to have become so burned out that no small effort can revitalize their spirits.